WHAT IS CLAIMED IS:

1. A method of controlling dispersion of at least one material in a microfluidic device, the method comprising:

flowing the at least one material under pressure in a microchannel of the microfluidic device;

capturing the at least one material in at least one localized electric field generated in at least one portion of the microchannel; and,

releasing the at least one material from the at least one localized electric field in the at least one portion of the microchannel, thereby controlling the dispersion of the at least one material in the microfluidic device.

2. The method of claim 1, wherein at least one discrete sample comprises the at least one material.

3. The method of claim 1, wherein the at least one material comprises at least one polar material or at least one polarizable material.

4. The method of claim 1, wherein the at least one material is dielectrophoretically captured in the at least one localized electric field.

5. The method of claim 1, wherein the at least one material comprises a polarity or polarizability that is greater than a polarity or polarizability of at least one fluid that comprises the at least one material.

6. The method of claim 1, comprising flowing at least one fluid continuously through the microchannel during operation of the microfluidic device using at least one fluid pressure force modulator.

7. The method of claim 1, wherein the capturing step comprises activating the at least one localized electric field during pressure-based flow of the at least one material through the at least one portion of the microchannel.

8. The method of claim 1, wherein the capturing step is reversible.

9. The method of claim 1, wherein lines of force of the at least one localized electric field are directed substantially vertically or substantially horizontally in the at least one portion of the microchannel.

10. The method of claim 1, wherein the releasing step comprises deactivating the at least one localized electric field during pressure-based flow of at least one fluid through the at least one portion of the microchannel.

11. The method of claim 1, wherein the at least one localized electric field is generated by at least one alternating current source or by at least one direct current source; or,

wherein the at least one localized electric field is capable of being selectively activated or deactivated.

12. The method of claim 1, further comprising controlling temperature within the microchannel with at least one joule heating electrode disposed in at least one microscale cavity that fluidly communicates with the microchannel, which joule heating electrode is operably connected to a current source.

13. The method of claim 12, wherein the at least one joule heating electrode disposed in the at least one microscale cavity further controls the dispersion of the at least one material in the microfluidic device.

14. The method of claim 12, wherein at least a portion of the at least one microscale cavity is wider than a cross-section of at least a portion of the microchannel.

15. The method of claim 1, further comprising altering one or more dielectrophoretic properties of the at least one material prior to performing the capturing step.

16. The method of claim 15, wherein the one or more dielectrophoretic properties of the at least one material are altered by attaching each material component to at least one separate microbead.

17. The method of claim 1, wherein the at least one portion of the microchannel comprises at least one capture electrode configuration for generating the at least one localized electric field.

18. The method of claim 17, wherein the at least one capture electrode configuration comprises at least one capture electrode disposed between at least a first field electrode portion and at least a second field electrode portion, wherein at least a segment of the at least one capture electrode and the first and second field electrode portions are at least partially disposed within the microchannel.

19. The method of claim 18, further comprising at least one electrical control system configured to permit current to flow through at least one fluid disposed between the first and second field electrode portions in the microchannel.

20. The method of claim 18, wherein the at least one capture electrode is directly or indirectly connected to at least one electrical control system.

21. The method of claim 18, wherein the at least one capture electrode comprises a higher conductivity than at least one fluid that comprises the at least one material in the at least one portion of the microchannel.

22. The method of claim 18, wherein the at least one capture electrode or the first and second field electrode portions are fabricated from at least one metallic substance.

23. The method of claim 18, wherein the at least one capture electrode configuration comprises multiple capture electrodes, wherein each capture electrode is disposed at least partially in or proximal to a different portion of the microchannel and is capable of generating at least one separate localized electric field.

24. The method of claim 23, wherein each of the multiple capture electrodes is regularly or irregularly spaced from one another along a length of the microchannel; or,

wherein each of the multiple capture electrodes is disposed at least about one μm from one another along a length of the microchannel.

25. The method of claim 17, wherein the at least one capture electrode configuration comprises at least one capture electrode pair.

26. The method of claim 25, wherein each electrode of the at least one capture electrode pair is connected to at least one electrical control system.

27. The method of claim 25, wherein the at least one capture electrode pair comprises one or more of:

at least one first capture electrode disposed at least partially in or proximal to a top portion of the microchannel and at least one second capture electrode disposed at least partially in or proximal to a bottom portion of the microchannel, wherein the top and bottom portions oppose each other in the microchannel; or,

at least one first capture electrode disposed at least partially in or proximal to a first side portion of the microchannel and at least one second capture electrode disposed at least partially in or proximal to a second side portion of the microchannel, wherein the first and second side portions oppose each other in the microchannel; or,

at least one first capture electrode and at least one second capture electrode, both disposed in or proximal to at least one top, bottom, or side portion of the microchannel.

28. The method of claim 27, wherein at least one segment of each electrode in the at least one capture electrode pair substantially oppose each other in the microchannel.

29. The method of claim 25, wherein the at least one capture electrode configuration comprises multiple capture electrode pairs, wherein each electrode of each capture electrode pair is disposed at least partially in or proximal to a different portion of the microchannel.

30. The method of claim 29, wherein each of the multiple capture electrode pairs is capable of generating at least one separate localized electric field.

31. The method of claim 29, wherein each of the multiple capture electrode pairs is regularly or irregularly spaced from one another along a length of the microchannel; or,

wherein each of the multiple capture electrode pairs is disposed at least about one μm from one another along a length of the microchannel.

32. The method of claim 1, comprising flowing the at least one material into the microchannel from at least one cavity that fluidly communicates with the microchannel.

33. The method of claim 32, wherein the at least one cavity comprises one or more of: an additional microchannel, a port, or a capillary element that extends from the microfluidic device.

34. The method of claim 1, the method further comprising pinching fluid flow in the microchannel from at least one direction upon introduction of the at least one material into the microchannel.

35. The method of claim 34, wherein the pinching and capturing steps occur substantially at the same time.

36. The method of claim 1, further comprising repeating one or more of the flowing, capturing, or releasing steps at least once, wherein each time the capturing step is repeated, the at least one material is captured in at least one other localized electric field in at least one other portion of the microchannel that is downstream from preceding capturing step portions.

37. The method of claim 36, comprising controlling the dispersion of a plurality of discrete samples of the at least one material by sequentially introducing each discrete sample into the microchannel following at least one cycle of the flowing, capturing, and releasing steps.

38. The method of claim 37, wherein at least two of the plurality of discrete samples of the at least one material comprise different constituent materials or different sample sizes.

39. The method of claim 37, further comprising introducing a selected volume of at least one spacer fluid into the microchannel following the introduction of each sample of the at least one material into the microchannel to provide a fluid barrier between each adjacent pair of the discrete samples.

40. The method of claim 39, wherein the at least one spacer fluid comprises at least one buffer.

41. The method of claim 36, comprising capturing multiple discrete samples of the at least one material, wherein each discrete sample is captured in a separate portion of the microchannel, wherein each separate portion is capable of generating at least one separate localized electric field.

42. The method of claim 41, wherein at least two of the multiple captured discrete samples comprise different constituent materials.

43. The method of claim 41, wherein at least one portion of the microfluidic device comprises a plurality of parallel microchannels, the method further comprising capturing the multiple discrete samples of the at least one material in separate portions of each of the plurality of parallel microchannels, wherein each of the separate portions is capable of generating at least one independent localized electric field.

44. The method of claim 43, wherein the plurality of parallel microchannels comprise at least about 6, 12, 24, 48, 96, or more parallel microchannels.

45. The method of claim 44, further comprising assaying the multiple discrete samples for one or more detectable properties in each of the plurality of parallel microchannels simultaneously using at least one detector disposed in or proximal to the plurality of parallel microchannels.

46. The method of claim 41, wherein each of the multiple captured discrete samples comprises a plurality of captured first nucleic acids, the method further comprising:

flowing a set of second nucleic acids under pressure into the microchannel;

hybridizing the set of second nucleic acids to the plurality of captured first nucleic acids to provide a set of hybridized nucleic acids; and,

elongating the set of hybridized nucleic acids.

47. The method of claim 46, comprising elongating the set of hybridized nucleic acids with at least one thermostable polymerase, reverse transcriptase, or ligase.

48. The method of claim 46, wherein at least two of the multiple captured discrete samples comprise different captured first nucleic acids.

49. The method of claim 46, the flowing step further comprising flowing one or more sets of molecular beacons along with the set of second nucleic acids, wherein the one or more sets of molecular beacons hybridize to the plurality of captured first nucleic acids or to the set of second nucleic acids to produce at least one detectable signal.

50. The method of claim 46, wherein the plurality of captured first nucleic acids and the set of second nucleic acids each independently comprises one or more of: primer nucleic acids, DNAs, RNAs, gDNAs, cDNAs, mtDNAs, mRNAs, tRNAs, snRNAs or rRNAs.

51. The method of claim 46, the method further comprising:

denaturing the set of hybridized nucleic acids to provide a set of denatured nucleic acids;

rehybridizing the set of denatured nucleic acids to provide a set of further hybridized nucleic acids;

extending the set of further hybridized nucleic acids; and, optionally:

repeating the denaturing, rehybridizing, and extending steps at least once.

52. The method of claim 51, comprising extending the set of further hybridized nucleic acids with at least one thermostable polymerase, reverse transcriptase, or ligase.

53. The method of claims 46 or 51, wherein the steps occur in at least one nucleic acid amplification process.

54. The method of claim 53, wherein the at least one nucleic acid amplification process comprises a polymerase chain reaction or a ligase chain reaction.

55. The method of claim 53, wherein the steps occur in at least one nucleic acid sequencing process.

56. The method of claims 46 or 51, further comprising controlling temperature within the microchannel by using at least one selectable heating technique.

57. The method of claim 56, wherein the at least one selectable heating technique comprises joule heating.

58. The method of claim 51, further comprising flowing the extended set of further hybridized nucleic acids from the microchannel into at least one other cavity of the microfluidic device using at least one fluid pressure force modulator.

59. The method of claim 58, wherein dispersion of the extended set of further hybridized nucleic acids is controlled during the second flowing step.

60. The method of claim 51, wherein subsequent to at least one of the denaturing or repeated denaturing steps, at least one set of molecular beacons is hybridized to the set of denatured nucleic acids to produce at least one detectable signal.

61. The method of claims 49 or 60, further comprising detecting the at least one detectable signal.

62. The method of claim 41, further comprising flowing at least one additional material through the microchannel comprising the multiple captured discrete samples of the at least one material.

63. The method of claim 62, wherein the at least one material and the at least one additional material each independently comprises one or more of: a cell, a set of cells, a microbead, a set of microbeads, a functionalized microbead, a set of functionalized microbeads, a reagent, a set of reagents, an atom, a set of atoms, a molecule, a set of molecules, a nucleic acid primer, a set of nucleic acid primers, a nucleic acid, a set nucleic acids, a neurotransmitter, a set of neurotransmitters, an antigen, a set of antigens, a protein, a set of proteins, a peptide, a set of peptides, a lipid, a set of lipids, a carbohydrate, a set of carbohydrates, an organic molecule, a set of organic molecules, an inorganic molecule, a set of inorganic molecules, a drug, a set of drugs, a receptor ligand, a set of receptor ligands, an antibody, a set of antibodies, a cytokine, a set of cytokines, a chemokine, a set of chemokines, a hormone, or a set of hormones.

64. The method of claim 62, further comprising detecting at least one detectable signal produced by one or more interactions of the at least one additional material with one or more of the multiple captured discrete samples of the at least one material.

65. The method of claim 64, further comprising separating one or more of the at least one material, the at least one additional material, or products of the one or more interactions.

66. The method of claim 64, further comprising comparing the at least one detectable signal with at least one standard.

67. The method of claim 62, wherein the at least one material and the at least one additional material each comprise one or more labels, wherein the one or more labels are identical to or different from one another.

68. The method of claim 67, wherein the one or more labels comprise one or more of: a donor molecule, an acceptor molecule, a fluorophore, or a chromophore.

69. A method of amplifying nucleic acids, the method comprising:

positioning at least one set of first nucleic acids in at least one portion of a microchannel;

flowing at least one set of second nucleic acids under pressure into the microchannel;

capturing the at least one set of first nucleic acids in at least one localized electric field generated in the at least one portion of the microchannel;

hybridizing the at least one set of second nucleic acids to the at least one set of captured first nucleic acids to provide a set of hybridized nucleic acids; and,

elongating the set of hybridized nucleic acids, thereby amplifying the nucleic acids.

70. The method of claim 69, comprising positioning at least two sets of first nucleic acids, wherein each set comprises different first nucleic acids.

71. The method of claim 69, the flowing step further comprising flowing one or more sets of molecular beacons along with the set of second nucleic acids, wherein the one or more sets of molecular beacons hybridize to the at least one set of captured first nucleic acids or to the set of second nucleic acids to produce at least one detectable signal.

72. The method of claim 69, wherein the at least one set of captured first nucleic acids and the at least one set of second nucleic acids each independently comprises one or more of: primer nucleic acids, DNAs, RNAs, gDNAs, cDNAs, mtDNAs, mRNAs, tRNAs, snRNAs, or rRNAs.

73. The method of claim 69, comprising elongating the set of hybridized nucleic acids with at least one thermostable polymerase, reverse transcriptase, or ligase.

74. The method of claim 69, the positioning step comprising disposing meltable gel embedded first nucleic acids in multiple portions of the microchannel.

75. The method of claim 74, the capturing step comprising activating a plurality of localized electric fields, wherein each localized electric field corresponds to at least one of the multiple portions of the microchannel comprising the meltable gel embedded first nucleic acids such that the localized electric fields melt the meltable gel and capture the first nucleic acids embedded therein.

76. The method of claim 69, the method further comprising:

denaturing the set of hybridized nucleic acids to provide a set of denatured nucleic acids;

rehybridizing the set of denatured nucleic acids to provide a set of further hybridized nucleic acids;

extending the set of further hybridized nucleic acids, thereby further amplifying the set of nucleic acids; and, optionally:

repeating the denaturing, rehybridizing, and extending steps at least once.

77. The method of claim 76, comprising extending the set of further hybridized nucleic acids with at least one thermostable polymerase, reverse transcriptase, or ligase.

78. The method of claims 69 or 76, wherein the steps occur in one or more polymerase chain reactions or one or more ligase chain reactions.

79. The method of claims 69 or 76, further comprising controlling temperature within the microchannel by using at least one selectable heating technique.

80. The method of claim 79, wherein the at least one selectable heating technique comprises joule heating.

81. The method of claim 76, further comprising flowing the extended set of further hybridized nucleic acids from the microchannel into at least one other cavity of the microfluidic device using at least one fluid pressure force modulator.

82. The method of claim 81, wherein dispersion of the extended set of further hybridized nucleic acids is controlled during the second flowing step.

83. The method of claim 76, wherein subsequent to at least one of the denaturing or repeated denaturing steps, at least one set of molecular beacons is hybridized to the set of denatured nucleic acids to produce at least one detectable signal.

84. The method of claims 69 or 83, further comprising detecting the at least one detectable signal.

85. A microfluidic device, comprising:

a substrate having at least one surface;

at least one microchannel fabricated into the at least one surface of the substrate, wherein the at least one microchannel comprises at least one capture electrode configuration;

at least one source of at least one material in fluid communication with the at least one microchannel;

at least one electrical control system operably connected to the at least one capture electrode configuration for generating at least one localized electric field in the at least one capture electrode configuration to reversibly capture the at least one material;

at least one pressure-based fluid direction system operably connected to the microfluidic device for inducing flow of the at least one material in the at least one microchannel; and,

a cover mated with the at least one surface of the substrate.

86. The microfluidic device of claim 85, wherein the at least one microchannel comprises a plurality of parallel microchannels fabricated into the at least one surface of the substrate, wherein each parallel microchannel comprises at least one capture electrode configuration.

87. The microfluidic device of claim 85, wherein the at least one electrical field source comprises one or more of: a selectable electrical field source, an alternating current source, a direct current source, or an arbitrary current source.

88. The microfluidic device of claim 85, wherein the at least one pressure-based fluid direction system comprises at least one fluid pressure force modulator.

89. The microfluidic device of claim 85, further comprising at least one joule heating electrode disposed in at least one microscale cavity that fluidly communicates with the at least one microchannel, which joule heating electrode is operably connected to the at least one electrical control system to control temperature within the at least one microchannel.

90. The microfluidic device of claim 89, wherein at least a portion of the at least one microscale cavity is wider than a cross-section of at least a portion of the at least one microchannel.

91. The microfluidic device of claim 85, wherein the at least one capture electrode configuration comprises at least one capture electrode disposed between at least a first field electrode portion and at least a second field electrode portion, wherein at least a segment of the at least one capture electrode and the first and second field electrode portions are at least partially disposed within the microchannel.

92. The microfluidic device of claim 91, wherein the at least one electrical control system is operably connected to the first and second field electrode portions to permit current to flow through at least one fluid disposed between the first and second field electrode portions in the microchannel to generate the at least one localized electric field.

93. The microfluidic device of claim 91, wherein the at least one capture electrode comprises a higher conductivity than at least one fluid that comprises the at least one material in the at least one microchannel.

94. The microfluidic device of claim 91, wherein the at least one capture electrode or the first and second field electrode portions are fabricated from at least one metallic substance.

95. The microfluidic device of claim 91, wherein the at least one capture electrode configuration comprises multiple capture electrodes, wherein each capture electrode is disposed at least partially in or proximal to a different portion of the microchannel and is capable of generating at least one separate localized electric field.

96. The microfluidic device of claim 95, wherein each of the multiple capture electrodes is regularly or irregularly spaced from one another along a length of the microchannel; or,

wherein each of the multiple capture electrodes is disposed at least about one μm from one another along a length of the microchannel.

97. The microfluidic device of claim 95, wherein the at least one capture electrode configuration comprises at least about 2, 3, 4, 5, 10, 15, 25, 50, 100, 500, 1000, or more separate capture electrodes.

98. The microfluidic device of claim 85, wherein the at least one capture electrode configuration comprises at least one capture electrode pair.

99. The microfluidic device of claim 98, wherein each electrode of the at least one capture electrode pair is connected to the at least one electrical control system.

100. The microfluidic device of claim 98, wherein the at least one capture electrode pair comprises one or more of:

at least one first capture electrode disposed at least partially in or proximal to a top portion of the at least one microchannel and at least one second capture electrode disposed at least partially in or proximal to a bottom portion of the at least one microchannel, wherein the top and bottom portions oppose each other in the at least one microchannel; or,

at least one first capture electrode disposed at least partially in or proximal to a first side portion of the at least one microchannel and at least one second capture electrode disposed at least partially in or proximal to a second side portion of the at least one microchannel, wherein the first and second side portions oppose each other in the at least one microchannel; or,

at least one first capture electrode and at least one second capture electrode, both disposed in or proximal to at least one top, bottom, or side portion of the at least one microchannel.

101. The microfluidic device of claim 100, wherein at least one segment of each electrode in the at least one capture electrode pair substantially oppose each other in the at least one microchannel.

102. The microfluidic device of claim 101, wherein individual electrodes in the at least one capture electrode pair comprise at least one shape independently selected from: a regular n-sided polygon, an irregular n-sided polygon, a triangle, a square, a rectangle, a trapezoid, a circle, and an oval.

103. The microfluidic device of claim 101, wherein individual electrodes in the at least one capture electrode pair are separated from each another by at least about one μm; or,

wherein individual electrodes in the at least one capture electrode pair comprise opposing electrically conductive wires disposed at angles relative to one another in the range of from about 0° to about 90°.

104. The microfluidic device of claim 101, wherein individual electrodes in the at least one capture electrode pair independently comprise one or more of: an electrically conductive wire, an electrically conductive coating, or an electrically conductive plate; or,

wherein individual electrodes in the at least one capture electrode pair independently comprise a surface area that ranges from about one μm^2 to about an entire internal surface of the at least one microchannel.

105. The microfluidic device of claim 98, wherein the at least one capture electrode configuration comprises multiple capture electrode pairs, wherein each electrode of each capture electrode pair is disposed at least partially in or proximal to a different portion of the at least one microchannel.

106. The microfluidic device of claim 105, wherein each of the multiple capture electrode pairs is capable of generating at least one separate localized electric field.

107. The microfluidic device of claim 105, wherein each of the multiple capture electrode pairs is regularly or irregularly spaced from one another along a length of the at least one microchannel; or,

wherein each of the multiple capture electrode pairs is disposed at least about one μm from one another along a length of the at least one microchannel.

108. The microfluidic device of claim 105, wherein the at least one capture electrode configuration comprises at least about 2, 3, 4, 5, 10, 15, 25, 50, 100, 500, 1000, or more separate capture electrode pairs.

109. The microfluidic device of claim 105, wherein individual localized electric fields generated by the capture electrode pairs are each independently activated or deactivated.

110. The microfluidic device of claim 85, further comprising an integrated system comprising:

a computer or a computer readable medium comprising at least one instruction set for selectively activating or deactivating the at least one localized electric field in the at least one material capture portion; and,

a controller/detector apparatus configured to receive the microfluidic device, the controller/detector apparatus comprising a detection system and a material transport system, the detection and transport systems being operably interfaced with the microfluidic device.

111. The microfluidic device of claim 110, wherein the detection system comprises one or more of: an emission spectroscope, a fluorescence spectroscope, a phosphorescence spectroscope, a luminescence spectroscope, a spectrophotometer, a photometer, a nuclear magnetic resonance spectrometer, an electron paramagnetic resonance spectrometer, an electron spin resonance spectroscope, a turbidimeter, a

nephelometer, a Raman spectroscope, a refractometer, an interferometer, an x-ray diffraction analyzer, an electron diffraction analyzer, a polarimeter, an optical rotary dispersion analyzer, a circular dichroism spectrometer, a potentiometer, a chronopotentiometer, a coulometer, an amperometer, a conductometer, a gravimeter, a mass spectrometer, a thermal gravimeter, a titrimeter, a differential scanning colorimeter, a radioactive activation analyzer, or a radioactive isotopic dilution analyzer.